# LECTURE NOTE
# WATER SUPPLY & WASTE WATER ENGINEERING
# 5TH SEMETER
# Diploma (Civil Engineering)

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chapter 1 : Introduction to water supply, Quantity and quality of water

## 1.1 necessity of treated water supply:

- No life can exist without water, as it is essential for life as air is.

- It is necessary that water required must be good enough and it should satisfy all the physical, chemical and biological parameters/stds.

- treated water means free from unwanted impurities, or harmful chemical compounds or bacteria in it.

- Besides promoting overall hygiene and public health, it should ensure safety against fire, and should also satisfy the industrial needs.

- a perfect water supply means it should ensure that clean water remains clean up until it reaches the customer / taps.

- Treated water is the 'best' way to prevent spread of many diseases that can cause havoc to the humanity or to a city.

## 1.2 Per capita demand of water (q):-

- It is the annual average amount of daily water required by one person and includes the domestic use, industrial use, commercial use, public use, wastes, thefts etc.

- per capita demand represented in lpcd or gpcd.

  lpcd — litres per capita per day.

  gpcd — gallons per capita per day         (Per capita - Per Person)

- simply lpcd means — requirement of water per person per day.

- Total water demand to a city = lpcd × population of city

- Lpcd of a city = $\dfrac{\text{total yearly water req. of the city in litres}}{365 \times \text{design population}}$

- For an average indian city, as per I.S code, the per capita demand may be taken as

| use | demand (lpcd) |
|---|---|
| (i) domestic use (residential) | 200 |
| (ii) Industrial use | 50 |
| (iii) commercial use (hotels, malls, offices) | 20 |
| (iv) public use | 10 |
| (v) wastes, thefts etc | 55 |
| total | 335 |

= per capita demand.

Variation in demands :-

(I) seasonal variations — summer — higher

  winter    lesser

  rainy — much lesser

(II) daily variations — sundays/holidays/festivals — higher demand

  weekdays — lesser

(III) hourly variation - morning ↑
         afternoon lesser
         evening   – higher demand
         night    – lesser

<u>assessment</u> of normal variations –

(1) maximum daily demand $= 1.8 \times$ avg daily demand $(q)$

(2) maximum hourly demand $= 1.5 \times$ avg hourly demand of max day

$$= 1.5 \times \frac{\text{maximum daily demand}}{24}$$

$$= 1.5 \times \frac{(1.8 \times \text{avg daily demand})}{24}$$

$$= 2.7 \times (q/24) \quad \text{or}$$

$$= 2.7 \times \text{annual avg hourly demand}$$

also by Goodrich formula:

(1) daily variation ;   $\dfrac{\text{maximum daily}}{\text{avg daily}} = 180\%.$

(2) weekly variation ;   $\dfrac{\text{maximum weekly}}{\text{avg weekly}} = 148\%.$

(3) monthly variation :   $\dfrac{\text{max}^m \text{ monthly}}{\text{avg monthly}} = 128\%$

            • Sources of supply – max$^m$ daily.

<u>Factors affecting demand</u>     • Pipe main   – max$^m$ daily

            • distribution pipe – max$^m$ hourly

1. Size of city ( big cities, population )

2. Climatic conditions ( hotter/dry, colder )

3. Type of gentry and habits of people. ( rich, middle class )

4. Industrial and commercial activities

(5) quality of water supply

(6) pressure in distribution system

(7) development of sewage facilities

(8) System of supply (either continous supply / only for peak period)

(9) cost of water

(10) Policy of metering or method of changing.

## 1.3 Methods of forcasting the population :-

as we know,

total water demand to a city = lpcd × population of city
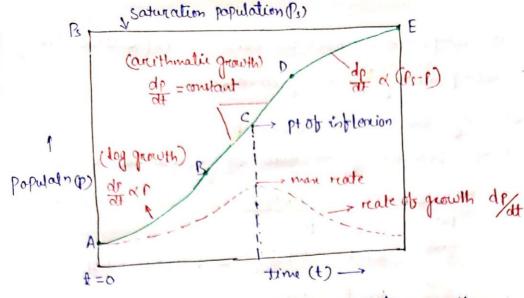
so population of the city to be calculated / estimated.

Factores affecting
① Birth rate ↑
② Death rate ↓
③ migration ↑ or ↓

industrialization ──→ migration ↑

immigration restriction ──→ migration ↓

Note    population follows the [logistic - curve] for growth.

The curve is S - shaped.

Logistic curve for population growth

AB — new city population increasing (log growth)

BD — straight line (linear growth) → arithmatic growth

DE — growth rate starts decreasing

## methods

① Arithmetic increase method :—

– assumption: that population increases at a constant rate.

i.e $dp/dt$ = constant

– city which are large and old, dev has taken place

$$\boxed{P_n = P_0 + \bar{x}\, n}$$

where, $P_n$ = forecasted population after 'n' decades from present

$P_0$ = population at present

$\bar{x}$ = average of population increase.

$n$ = no. of decades between now and future

② Geometric Increase method :—

– assumption: percentage increase between each decade is constant. or constant percentage growth rate.